

SAP White Paper



# ADAPTIVE SUPPLY CHAIN NETWORKS

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## **EXECUTIVE SUMMARY**

Falling margins, globalization, and accelerating innovation cycles are forcing businesses to switch from traditional supply chains to adaptive supply chain networks that possess the flexibility needed to respond to their environment in near real time.

During the transition, companies must map the three key process enablers – the management of visibility, velocity, and variability – to the three key information enablers – quality, timeliness, and depth of information. Leveraging technology, including new technologies such as agents and RFID, is crucial to a company's success.

SAP is well-positioned to support companies as they evolve through the integrated, collaborative, and adaptive stages by providing the necessary expertise, experience, and technology.

## **THE ADAPTIVE EVOLUTION**

Adaptation is a natural condition in all aspects of life. From living organisms to businesses, survival often depends on the ability to adapt. In today's rapidly changing marketplace, adaptation is no longer optional; it is mandatory. The Internet and the ubiquity of information technology are requiring businesses to possess the flexibility to continually change and adapt to their environment. That's where adaptive supply chain networks come into play.

## **DEFINITION: ADAPTIVE SUPPLY CHAIN NETWORKS**

Over the past few years, analysis of successful manufacturing and retail companies shows that in today's hyper-competitive business environment, supply chain efficiency is a necessary condition for survival. However, as we approach an age of super efficiency, adaptive supply chain networks, which have redundancies built in to withstand unpredictable shocks, are replacing traditional supply chains. Adaptive supply chain networks possess the flexibility to continually morph and respond to the environment in near real time without compromising on operational and financial efficiencies. These networks seamlessly connect supply, planning, manufacturing, and distribution operations to critical enterprise applications and provide near real-time visibility across the supply network, thereby enabling rapid decision making and optimal execution.

## THE SHRINKAGE EFFECT

The March 5 2001, issue of *Fortune* magazine contains an analysis of the effect the Internet and information ubiquity are having on the business world: “Those celebrating ‘frictionless capitalism’ typically fail to note that companies often owe a majority of their profits to friction. Customer ignorance across all businesses has long been a reliable profit center. But with the Internet, consumers can compare prices, shop the globe, and get knowledge for next to nothing. Margins are bound to fall.”

This issue of falling margins has made the dream of frictionless capitalism a reality and has forced companies to focus on supply networks like never before. Falling margins are manifesting themselves in what is being defined as the “shrinkage effect,” which in turn is driving the momentum toward building adaptive supply chain networks.

Today’s companies need to adapt to many competitive pressures:

- Financial markets are increasingly demanding that companies use capital more efficiently.
- Other businesses are seeking global playing fields to maintain growth and diversify risk.
- Customers are demanding service as markets of one and forcing companies toward mass customization.
- Innovation cycles are continually accelerating.

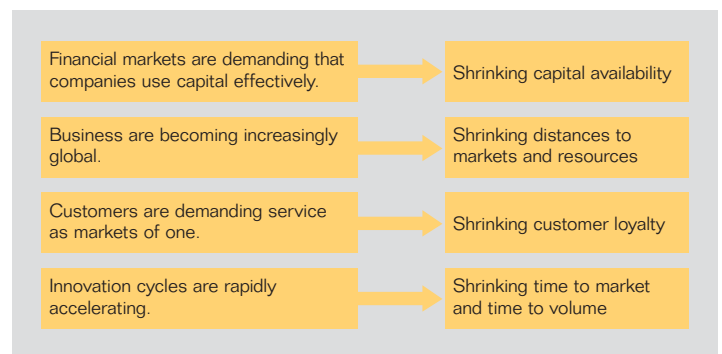


Figure 1: Shrinkage Effect on Business

These pressures on businesses are driving changes that have enormous implications for supply networks (see Figure 1):

- Shrinking capital availability is forcing companies to streamline manufacturing and supply operations and build efficiencies, which are critical to the supply network.
- While information ubiquity is driving and facilitating globalization, shrinking distances to markets and resources require levels of supply network visibility and collaboration that were not essential in traditional supply chains.
- Customers are armed with information about the real value of products, which is shrinking customer loyalty and requiring customer-service levels too expensive for companies that are unable to manage supply chain efficiencies.
- Shrinkages in the time available to build and launch products are forcing companies to innovate at velocities far greater than before.

Characteristic	Traditional Supply Chain	Adaptive Supply Chain Network
Information Propagation	Sequential and Slow	Parallel and Dynamic
Planning Horizon	Days/Weeks	Hours/Days
Planning Characteristics	Batch	Dynamic
Response Reaction	Days/Hours	Hours/Minutes
Analytics	Historical	Real-Time
Supplier Characteristics	Cost/Delivery	Network Capability
Control	Centralized	Distributed
Exception Management	Centralized/Manual	Distributed/Automated
Integration	Stand-Alone Point Solution	Intra- and Inter-Enterprise
Standards	Proprietary	Open

Table 1: Traditional Supply Chains Versus Adaptive Supply Chain Networks

As a result, companies are being forced to build supply networks that are far more responsive than the current sub-optimal and sequential supply chains. Processes traditionally managed by single enterprises are beginning to spread out across multiple enterprises. This means traditional supply chains will have to build the characteristics of adaptive supply chain networks (see Table 1) to be in a position to have the highest visibility, greatest velocity, and best ability to manage variability.

## ENABLING THE ADAPTIVE SUPPLY CHAIN NETWORK

Companies have to focus on and put in place key sequential enablers to manage the competitive pressures and make the adaptive supply chain network's vision come to life. Management of visibility, management of velocity, and management of variability across the supply network are the three key process enablers that need to be mapped to the three key information enablers – quality of information, timeliness of information, and depth of information – to maximize network responsiveness and thereby enhance the efficiency of value creation (see Figure 2).

### VISIBILITY AND INFORMATION QUALITY

As business relationships continue to become matrixed, visibility of quality information is rapidly becoming the fundamental building block for adaptive supply chain networks. Because competition is transitioning from among individual companies to among supply networks, visibility to both intra- and inter-organizational information is critical for rapid response. Information technology advances now make extended visibility across organizations possible. Information visibility of orders, plans, supplies, inventory, and shipments is key to successfully coordinating events across the network and to monitoring analytics that track the health of the network and allow for proactive action.

Theoretically, it is possible for an order captured by a retailer to be simultaneously propagated to the suppliers across the network and to have inventory checks made against it at all points. Distributors, logistics service providers, and all relevant departments across different organizations can have full visibility of the order flow, both into the system and back to the customer. The customer, in turn, can track the shipment of the order and make changes based on predefined rules.

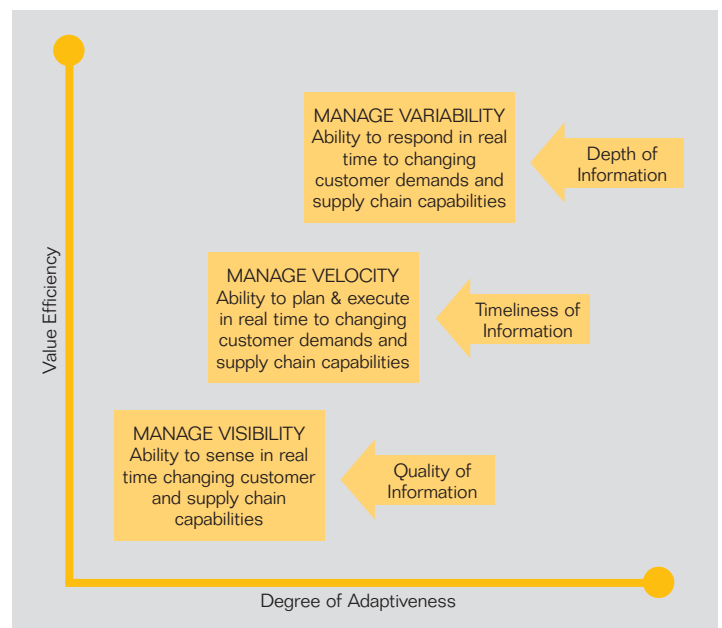


Figure 2: Enablers of Adaptive Supply Chain Networks

However, this scenario is still far from reality. Extracting the relevant supply chain data from multiple systems across the network and distributing this information to the relevant network nodes are still the big challenges. Therefore, the goal is to develop a system that provides total visibility of the order, automates order management, and monitors product use by customers across the network, replenishing when necessary, without having any manual intervention, other than exceptions.



### **VELOCITY AND INFORMATION TIMELINESS**

Once organizations overcome the visibility barrier and can receive accurate information, the next step is to increase the velocity of response by accessing and distributing information rapidly across the supply network. Velocity of response is rapidly becoming the key differentiator in business performance. The success of Dell Computer in the high-tech market, Wal-Mart in the retail market, and Toyota in the automobile market is closely linked to their access to timely information across their networks. These companies create value far greater than the average value created by their peers. That is because of their ability to plan rapidly and efficiently move both information and physical assets through the supply network at far greater velocities than their competition. This enables them to maintain margin parity with the competition and yet create returns on assets and invested capital that far exceed the norm. The velocity of value creation is the single most critical differentiator that adaptive supply chain networks can help create.

### **VARIABILITY AND INFORMATION DEPTH**

As businesses become more dynamic, demand will be less deterministic and the traditional practices of making forecasts over longer time horizons, order batching, and pushing inventory downstream will fail to yield necessary results. Simultaneously, as organizations undergo vertical disintegration to focus on their core competencies, managing variability will hold the key to efficient operations. Thus, in addition to the rapid distribution of quality information, the management of events far outside the four walls of the organization will require companies to provide access to depths of information to their supply network partners that is far greater than traditional surface transactional data.

As mass customization, build-to-order, configure-to-order, engineer-to-order, and assembly postponements all become standard manufacturing practices to manage variability, successful network partners will share information about orders, inventory, short-term and long-term plans, profit margins, and more to a far greater extent than is done today.

The most efficient networks will be those that successfully set aside concerns about confidential information and recognize that the end customer in the supply chain network – not the individual business-unit performance – will determine network profitability. With the battleground of the next decade shaping up to be supply chain versus supply chain, the depth of information visibility will allow companies to better manage variability and profitably execute on plans. Adaptive supply chain networks can leverage technology to rapidly extract relevant information across the network and build in robust planning and execution capabilities to adequately respond to variability introduced to the supply chain. Further, they are able to do so without a significant compromise on operational and financial efficiencies.

## EVOLUTION TO AN ADAPTIVE SUPPLY CHAIN NETWORK

To create an adaptive supply chain network, companies must advance through specific stages. The time it takes to evolve through the different stages will vary depending on the degree of technology, the process maturity, and the characteristics of the industry. However, once the network operations begin to streamline, benefits will become visible almost immediately. The three key stages to the evolution are integrated, collaborative, and adaptive (see Figure 3).

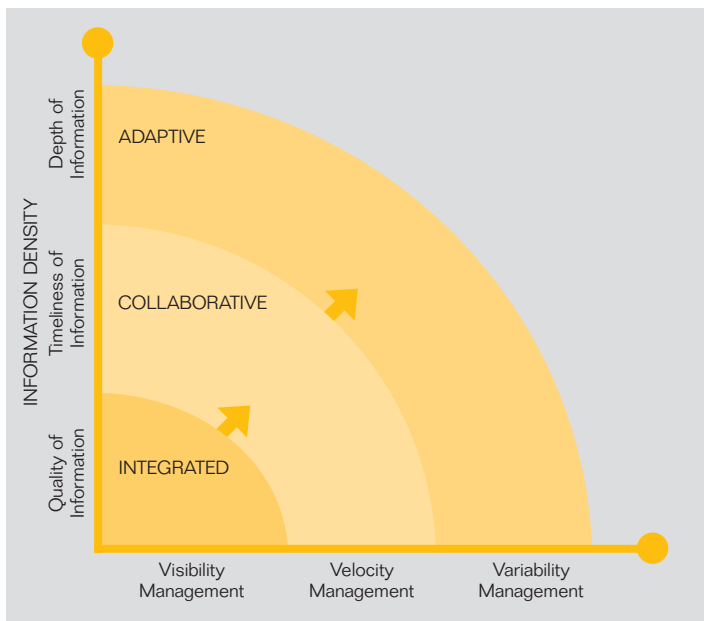


Figure 3: Stages to Adaptivity

### INTEGRATED

The first step in the evolution of an adaptive supply chain network is the integrated stage. Intra-enterprise integration is the basic driver for visibility within the organization. Supply chain integration is not a new concept, and many companies have already pursued this to gain competitiveness. Relational databases, client/server architecture, TCP/IP network protocols, multimedia, wireless technology, and the Internet have all prompted new levels of integration.

During the past few years, however, as new enterprise applications have emerged to improve operational visibility and efficiency, the companies that integrated such applications better than their peers have turned this benefit into a significant competitive advantage. For example, let's look at a company with an internal transportation management system that manages routings, rates, load tendering, and other execution functions. This system can be integrated to the company warehouse management system, the enterprise system, the transportation planning and scheduling system, and the supply chain event management application that tracks the shipments in transit. The extent of integration directly determines the degree of visibility that organizations have. Visibility, in turn, is the basic building block for an adaptive supply chain network.

### COLLABORATIVE

Once a company has overcome the integration challenge, the next step toward adaptivity is efficient collaboration. Companies rarely outcompete their peers because of differentiated technology. The crucial competitive edge is the ability of the supply network to exchange near real-time information and thereby execute better and faster, which is a direct derivative of the degree of collaboration.

As products increase in complexity and need to get delivered faster, product design, design for manufacturability, and distribution become more collaborative efforts among the enterprises in the network. Of course, companies were collaborating even before integrated applications. But the efficiency of collaboration – and therefore the planning and execution velocity – is severely impaired when collaboration takes place in nonintegrated environments. As companies transition to a mass-customization environment supported by a many-to-many relation across the network, the need for collaboration becomes more critical. Today's available technology can enable a real-time, efficient collaborative network, which is a big step toward becoming an adaptive enterprise.

### **ADAPTIVE**

An adaptive supply chain network is a loosely coupled group of organizations that work together to share transactional, operational, and financial data to enhance network competitiveness and optimize network profitability. An adaptive supply chain network leverages the integrated and collaborative network to manage variability better than other networks, and it fully capitalizes on the mass-customization environment and peer-to-peer relationships. Its visibility and velocity enable it to manage variability with a minimal loss of operational and financial efficiency.

Companies in an adaptive supply chain network successfully exploit the benefits of available-to-promise (ATP) capabilities. For example, a company receives a direct request from the customer order-entry system of an enterprise system. Order promising – using the collaboration request/promise architecture – routes this request instantaneously to all sites that could fill the order. Frequently there are multiple, hierarchically ordered partners with facilities in different geographic regions.

The ATP for available and planned inventory is then checked against the date requested by the customer and the appropriate quantities. If necessary, substitute choices are offered. The ATP results are sent to the transportation-planning engine of either the customer or the logistics service provider to determine transportation time and delivery dates. The results go back to the order-promising engine, which selects the fulfillment site and responds to the customer-order service application for approval. Order acceptance is then propagated back through the system, driving the acceptances. If the material isn't available, the order promising system can use the capable-to-promise functionality to address the production-scheduling engine and establish a date for the products promised.

All these steps are a system-to-system conversation, with customized alerts set up across the network to track exceptions and provide manual intervention if necessary. If the customer wants to make changes and places a modified order, the adaptive supply chain network can repeat the entire cycle and have a new response for the customer in hours or possibly minutes. Such fast and exception-tagged, automated responses are critical to dampening variability in an adaptive supply chain network.

## NEW TECHNOLOGY ENABLERS OF ADAPTIVE SUPPLY CHAIN NETWORKS

Although process and technology both play key roles in the transition to an adaptive supply chain network, the companies that most successfully leverage technology will significantly differentiate themselves from the competition. In addition to the traditional and well-understood supply chain management solutions of planning, execution, coordination, and networking, some of the exciting new technologies – agent, radio frequency identification (RFID), and Web services – are equally significant for adaptive supply chain networks.

### AGENT TECHNOLOGY

The discrete, dynamic, and distributed nature of data and applications requires software that not only responds to requests for information, but also intelligently anticipates, adapts, and supports users. Systems need to have the capability to help coordinate tasks among workers and help manage cooperation among distributed programs. In response to these requirements, researchers from several fields are banding together around a common broad agenda: the development of intelligent software agents.

Agents are packets of simple software capable of sensing the local environment, autonomously executing delegated tasks, and communicating results to designated entities, which could be human users, agents, applications, or business workflows. Designed to improve the velocity of response, agents are key to providing visibility into real-time distributed business processes across the supply network.

When necessary, several agents – each supporting a clearly discernible task or process – can interact with each other in a specified environment. They can execute a wide range of functional tasks, such as searching, comparing, learning, negotiating, and collaborating. These capabilities enhance the adaptability of the supply network, help to significantly reduce variability and the costs associated with exception management, and address some key barriers to widespread collaboration among supply network partners.

Designed to specifically address today's challenges to collaboration, agent-based systems complement enterprise resource planning (ERP) systems by leveraging their transactional data, while providing high flexibility. Through their modular design, agent-based systems allow individual agents to be flexibly removed or exchanged with more advanced agents. This leads to a highly fault-tolerant and self-organizing adaptive supply chain network. Agents can also be deployed to manage assets (for example, inventories and capacities) across company boundaries. By enabling collaboration among supply chain partners across multiple tiers, adaptive agents can drive total network yield to new levels. Two specific actions that agents enable include:

- Adaptive agents enable and automate information exchange in the network, thereby supporting the instant propagation of information across the network and allowing companies to make more intelligent decisions. The increased visibility and coordination across a multitiered network reduce the bullwhip effect.
- Adaptive agents increase the value of business transactions by allowing for real-time, active, and predictive monitoring of critical business events and parameters across the extended supply network. By detecting relevant conditions faster and formulating an optimized response faster through intelligent response, the occurrence of supply chain glitches that impact customers is less likely. The early identification of events can also help to prevent the ripple effects throughout the network through local resolution, which will lead to increased stability of optimized plans and schedules. Further, predictive monitoring can lead to the development of contingency plans before events impact the network, thereby enabling proactive risk management.

## **RFID TECHNOLOGY**

Even though radio frequency identification (RFID) technology has been around for some time, it has only recently become a significant enabling technology to enhance efficiencies across the supply network. RFID tags are thin, flexible smart labels containing a silicon chip. Attached to or embedded in products, boxes, and pallets, the tags create a people-free, wireless environment for tracking items as they travel through the supply chain. As a tag moves past a “read point” in the supply network, through different distribution centers, or through retail stores, its unique ID is automatically communicated back to a central database. This allows managers the real-time visibility necessary to make real-time decisions.

RFID significantly enhances the velocity of information flow by overcoming the limitations of other manual, data-collection methods. RFID does not require line-of-sight to communicate, and tags can survive in harsh environments such as extreme temperatures, moisture, and rough handling that often destroy optical bar codes.

As companies focus on the day-to-day, minute-to-minute optimization of their supply chains as a strategic advantage, RFID is perceived as a vital technology for accurate, timely visibility. Companies can take advantage of the ability of RFID to change data and its hands-off monitoring of packages as they move around the supply network. RFID technology can potentially smooth collaborative planning, forecasting, and replenishment. Also, it can execute level functionality within the distribution centers, potentially even eliminating mundane tasks such as issuing purchase orders or advance-ship notices.

Another advantage is that agent technology and RFID technology nearly complement each other perfectly and can significantly enhance the adaptivity of supply networks. Agent technology can help manage the large volumes of data captured through RFID readers and can help make intelligent decisions based on pre-configured rules or create exception alerts when necessary.

## **WEB SERVICES TECHNOLOGY**

The single largest challenge to building adaptive supply chain networks is the issue of cross-enterprise collaboration created because of the lack of standards and the prohibitive costs of building application integrators. Expected to reduce current integration costs by 70% to 80%, Web services technology could be the solution because it allows firms to interconnect software systems faster and cheaper.

Web services technology builds on established Internet technologies, such as TCP/IP and XML, plus three new standards, SOAP, WSDL, and UDDI, all of which are vendor neutral and backed by almost the entire software industry. Deploying Web services as a single connection method for both inter- and intra-enterprises is compelling, since it dramatically reduces or eliminates the need to define common interfaces. This means waiting for standardization at the application level is not necessary because Web services technology provides ways to discover interfaces and keep applications current.

Also, as portals become part of enterprise strategy, Web services can be expected to address the problems of nonstandardization by (1) providing a standard way to aggregate and present data, (2) reducing the number of portal objects that must be developed and maintained by the user, and (3) making it easier to integrate enterprise applications into any portal.

## VALUE PROPOSITION OF ADAPTIVE SUPPLY CHAIN NETWORKS

In addition to the benefits derived through traditional supply chain implementations, the increased visibility and velocity of adaptive supply chain networks can be expected to have a significant impact on key operational and financial benefits across the network.

On the operational side, inventory turns and customer fill rates should see a significant improvement, as well as capacity and labor utilization, obsolescence ratios, and service levels. On the financial side, ratios most significantly affected will be free cash flow, cash-to-cash cycle times, and reduced working capital. In addition, key business performance ratios likely to see improvement will include economic value added (EVA), return on assets (ROA), and return on invested capital (ROIC).

Using the leaders in the high-tech, automotive, and consumer-goods industries as a conservative benchmark, the top 5% of companies in each of these sectors have average business performance ratios that are better by a factor of 2 compared to their peer groups. Adaptive supply chain networks can be expected to create a similar, if not greater, competitive advantage.

## mySAP™ SUPPLY CHAIN MANAGEMENT AND ADAPTIVE SUPPLY CHAIN NETWORKS

Its breadth and depth of expertise makes SAP the best company today to provide almost the entire footprint of enterprise applications that will enable supply chains to transition from the integration stage to the collaborative stage to the adaptive supply chain network stage. The wide experience that SAP has had with technology provides SAP with the expertise to not only link the different solutions across the different stages, but also enables it to link the different networks.

For adaptive supply chain networks to be successful, the expertise to create the technology links and enable the free and accurate flow of real-time information is crucial. SAP is well-positioned to provide this expertise. SAP is the only company that has the full suite of solutions that enable transition to an adaptive supply chain network and back it up with robust integration technology.

mySAP Supply Chain Management offers solutions like demand planning, supply planning, distribution planning, and production planning to help optimize and integrate planning functions across the enterprise. Intra-enterprise optimal plans are augmented by the collaboration and networking solutions that facilitate the exchange of real-time transactional data across enterprises. Coordination solutions further enable visibility and help monitor events across the supply network and provide real-time analytics to enable intelligent decision support. Execution solutions then enable near real-time order promising and delivery, fulfillment coordination, and transportation execution, which are crucial to flexibly managing the network and reacting quickly to the demands imposed on it by practices like ATP/BTO/CTO and postponement-production policies. Fulfillment-coordination solutions contribute to the transparency of procedures by linking to the results of event management solutions, thereby enabling an up-to-date view of near real-time status of processes across the entire network.

In addition, SAP provides the technology to link these applications to the other enterprise solutions, including ERP, customer relationship management (CRM), supplier relationship management (SRM), and product life-cycle management (PLM) solutions. This allows organizations to respond quickly and effectively to events across organizations and across all essential functions.

For example, fulfillment coordination is the entrance and transition point to sales order fulfillment for distributed order management in mySAP™ Customer Relationship Management (mySAP™ CRM). This applies to both the availability check and the split of a sales order into work packages for the individual partners and its allocation. The creation of customer billing documents is carried out in mySAP CRM once the information about the actual outbound delivery to the goods recipient has arrived in SAP® Supply Chain Fulfillment Coordination via SAP® Supply Chain Event Management.

As businesses continue to demand technological innovations and seek new ways to leverage information, the need to have fast, accurate information, the ability to act on the information, and the ability to continuously monitor the results will all be crucial. Success can only be ensured with the right integration-technology expertise. SAP is strongly positioned to fulfill these needs for companies that embark on the journey to convert their linear supply chains to adaptive supply chain networks.

THE BEST-RUN E-BUSINESSES RUN SAP



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